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FOREST SERVICE

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ROCKY MOUNTAIN STAT

Forest Insect and Disease Conditions Intermountain Region 1978

COVER STORY

Infrared aerial photograph of mountain pine beetle damage in lodgepole pine, Clear Creek, Boise National Forest, Idaho. Dead trees appear green; live trees are red.

FOREST INSECT AND DISEASE CONDITIONS

INTERMOUNTAIN REGION

1978

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RESUMÉ OF CONDITIONS

Bark beetles remained the primary mortality agent in the Intermountain Region in 1978. Mountain pine beetle activity in lodgepole pine increased on the Boise and Payette National Forests, Idaho, and populations stabilized on the Caribou National Forest, Idaho, and Ashley National Forest, Utah. Infestations decreased on the Targhee National Forest, Idaho, and Bridger-Teton National Forest, Wyoming.

Douglas-fir beetle-caused tree mortality was essentially the same as in 1977; however, there were slight fluctuations in local infestations throughout the Region.

Pine engraver beetle activity on the Boise National Forest expanded and intensified in 1978. The number of mortality centers on the Payette National Forest increased slightly; however, decreases were also noted in some areas. The rapid increase which occurred in 1977 appears to have reached a plateau.

The first gypsy moth to be collected in the Intermountain West was pheromone trapped at Zion National Park, Utah, in 1978.

Western spruce budworm defoliation increased to one and a half million acres on six National Forests – Bridger-Teton, Boise, Targhee, Salmon, Caribou, and Challis. Increased defoliation was also noted in the Idaho Primitive Area and Grand Teton National Park. However, defoliation on the Payette National Forest decreased.

The dwarf mistletoes are still considered to be the most destructive pathogens to the Forests in the Intermountain Region. A Regionwide survey was conducted to provide incidence and volume loss information due to lodgepole and ponderosa pine dwarf mistletoe. Numerous needle diseases of pine and larch were observed in southern Idaho Forests during 1978. Some tree mortality due to the 1974-1977 drought was observed throughout the Region, mostly in ponderosa pine stands.

ENTOMOLOGY

BARK BEETLES

Mountain pine beetle, ***Dendroctonus ponderosae*** **Hopkins**

Lodgepole Pine

Static and decreasing trends in 1978 were prevalent for mountain pine beetle populations on most Forests in Region Four. Only the Boise and Payette National Forests suffered increased mortality.

Over 23,000 recently-killed lodgepole pine were sketch-mapped by aerial observers on the Boise National Forest. New infestations were noted north and east of Deadwood Reservoir (ca. 10,000 trees) and east of Smiths Ferry (ca. 4,000 lodgepole and ponderosa pine). Many of last year's mortality centers increased in size, such as the infestations around Graham along Johnson Creek and the North Fork of the Boise River, and near Atlanta along the Middle Fork of the Boise River.

On the Payette National Forest, increases in mountain pine beetle mortality were observed around Lost Valley Reservoir, Payette Lake, and in the Johnson Creek, and Paddy Flat areas. Approximately 28,000 dead trees were detected during aerial surveys.

On the Challis National Forest in Idaho, mountain pine beetle intensified in the Yankee Fork drainage.

Chronic infestations of mountain pine beetle continued at about the same level as noted during 1977 in the Warm Springs and Big Wood River drainages, Ketchum Ranger District, Sawtooth National Forest, Idaho. However, mountain pine beetle activity continued to decline on the Twin Falls Ranger District. Intensive ground surveys showed a decrease in mortality from 10,000 trees in 1977 to 8,000 in 1978.

On the Caribou and Ashley National Forests, mortality remained at a near-static level. Major centers on the Caribou were found in the drainages of Crow, Georgetown, Stump, Tincup, and McCoy Creeks. Most of the current mortality on the Ashley occurred in Alma Taylor Hollow, Taylor Mountain, Big Lake, Greendale Junction, and Carter Creek.

The massive infestation on the Targhee National Forest continued to decline in 1978. Survey data show a decrease in annual mortality from a high of 35 trees per acre infested in 1976 to 19 trees per acre in 1977 and a current loss rate of 13.5 trees per acre. Trend plot data collected since 1975 indicates an accumulated loss of 128 trees per acre. This represents the highest recorded mortality caused by the mountain pine beetle in Region 4 during the past 30 years. The only exception to the overall decline was found along the northwest side of the Teton Basin Ranger District, where mortality increased in stands along the forest fringe.

On the Bridger-Teton National Forest, losses continued to decline with locally heavy mortality occurring in Goosewing Creek, Bacon Creek, South Fork of the Gros Ventre River, Blackrock Creek, and Arizona Creek.

Ponderosa Pine

On the Boise National Forest, the few centers of mountain pine beetle in ponderosa pine noted during aerial detection surveys totaled about 1,100 trees, as opposed to 2,000 in 1977. On the Payette National Forest, a large area of some 12,000 lodgepole and ponderosa pine was detected around Payette Lake.

Several 50- and 100-tree groups of fading ponderosa pine were recorded on the Dixie National Forest, Utah, in the upper portions of North Creek and Pine Creek above Escalante.

Only scattered mortality occurred on the Ashley, Fishlake, and Manti-LaSal National Forests in Utah.

Douglas-fir beetle, ***Dendroctonus pseudotsugae*** **Hopkins**

The Douglas-fir beetle caused Douglas-fir mortality over much of the Boise National Forest in widely scattered groups of 3 to 30 trees. New areas were recorded, with 634 mortality centers representing about 8,000 trees. Mortality continued along the South Fork of the Payette River from Lowman to Grandjean and along the North and Middle Forks of the Boise River. Expanded mortality occurred along Clear Creek near Lowman and within the Silver Creek drainage east of Boiling Springs where areas that were infested in 1977 subsided but new ones appeared northward. Douglas-fir beetle-caused mortality persisted in the areas between Mores Creek and the Boise River as far west as the

North Fork of Cottonwood Creek, and from the North Fork of the Boise River south to the Middle Fork and east to Atlanta. Light mortality also appeared along the Deadwood River just south of the reservoir.

The Douglas-fir beetle remained the only abundant bark beetle encountered on the Salmon National Forest, Idaho. Douglas-fir mortality was again recorded in the Panther Creek drainage and in the vicinity south of North Fork, Idaho, but with less intensity than last year. These areas represent the last vestiges of the epidemic which began five years ago.

Renewed tree killing occurred in Grand Teton National Park, Wyoming, along the base of the Teton Mountains between Teton Village and Leigh Lake. This mortality can be seen from many of the scenic turnouts throughout the Park.

Douglas-fir beetle activity remained at low to static levels on the Payette National Forest. Generally, infestations decreased; however, a few new fader groups appeared east of Hells Canyon and in the Boulder Creek drainage. A marked decline in Douglas-fir beetle populations has occurred since 1976.

Douglas-fir beetle activity on the Caribou National Forest resulted in scattered mortality along the Caribou Range. The Targhee infestation continued to decline, with only widely scattered mortality along the south side of the Continental Divide.

Pine engraver beetle, *Ips pini* (Say)

Ips infestations in ponderosa pine stands on the Boise National Forest continued to intensify. Several new areas were heavily hit, especially on the west side of the Forest. *Ips* appeared in ponderosa pine around Idaho City, on land northeast of Boise along the Middle Fork of the Payette River, north of Crouch along the northern bank of the Middle Fork, near Garden Valley, and between the North Fork of Cottonwood Creek and Mores Creek (Figure 1). Large groups of faded ponderosa pine appeared along Dry Buck Creek west of Banks and along the east shore of Cascade Reservoir. On the east side of the Forest, new outbreaks of *Ips* were scattered around Featherville, along Fall Creek, and northeast of Prairie. A heavy infestation continued along Trail, Little Rattlesnake, and Rattlesnake Creeks.

Figure 1. **Ponderosa pine mortality caused by engraver beetles in the Town Creek Plantation, Idaho City Ranger District, Boise National Forest.**

Ips populations on the Payette National Forest were variable this year. Approximately 6,000 ponderosa pine were attacked in 183 mortality centers. New groups were recorded along the Salmon River near Studebaker Saddle and the Fingers. Increases were noted in the area west of Council along Hornet Ridge. Outbreaks south of Lost Valley Reservoir and along the Little Salmon River declined in 1978.

Western pine beetle, *Dendroctonus brevicomis* (LeConte)

Western pine beetle-caused mortality was again minimal. On the Boise National Forest, 20 small fader groups were scattered on the Forest. No mortality was recorded around Sagehen Reservoir where salvage logging in 1976 was undertaken to thin overstocked stands and reduce the number of infested trees.

In conjunction with last year's rapid decline from 1976 populations on the Payette National Forest, only 23 mortality centers (representing about 400 trees) were noted during aerial detection surveys. Groups of

dead trees were found in three major areas: Bear Wallow (ca. 200 trees), Freight Landing (ca. 75 trees), and south of Hornet Ranger Station (less than 50 trees).

Jeffrey pine beetle, *Dendroctonus jeffreyi* **Hopkins**

Mortality in Jeffrey pine on the Toiyabe National Forest and adjacent State and private lands in Nevada and California has been slowly increasing since 1975. Widely scattered tree killing occurred throughout the pine type from Mount Ina Coolbrith northwest of Reno south to Bridgeport. Group killing of host trees occurred in the southwest corner of Dog Valley, in the Winter Creek drainage near Washoe City, along the east side of Tahoe Basin from China Garden to Lincoln Park, and in several locations in the vicinity of Markleeville.

Increases in insect-associated mortality over the last four years is thought to be, in part, a result of extreme drought conditions which occurred from 1974 to 1977. Ground surveys indicate that the majority of mortality is located in areas which are marginally productive because of rocky, coarse-textured, or thin soils which have low moisture-holding capacity.

Spruce beetle, *Dendroctonus rufipennis* **(Kirby)**

Throughout the Region, Engelmann spruce mortality caused by the spruce beetle was at an all-time low. Only single-tree sites were recorded on the Manti-LaSal National Forest in Utah. On the Fishlake National Forest, eight mortality centers were recorded with a total of approximately 60 infested trees.

Western balsam bark beetle, *Dryocoetes confusus* **Swaine**

Mortality of subalpine fir caused by this bark beetle increased throughout Utah, Wyoming, and southeast Idaho during 1978. Two major concentrations occurred along the west slopes of the Escalante Mountains in Utah and in the Teton Wilderness Area in Wyoming.

DEFOLIATORS

Western spruce budworm, *Choristoneura occidentalis* Freeman

Results of the annual aerial detection survey indicate that defoliation caused by the western spruce budworm has increased from slightly less than one million acres in 1977 to one and a half million in 1978. The largest acreage increases occurred on the Bridger-Teton, Boise, Caribou, Targhee, and Salmon National Forests. Total acres recorded on the Payette National Forest were less than that recorded in 1977.

Defoliation on the Bridger-Teton National Forest was at a level above that in 1976, following a 1977 decline. Major expansions occurred in the drainages of Mosquito, Fall, upper Willow, and lower Granite Creeks.

On the Boise National Forest, budworm defoliation expanded from 132,100 to 228,000 acres. Heavy defoliation occurred west and south of Cascade Reservoir, extending to the perimeter of the host type near Sagehen Reservoir, Emmett Ranger District. Infestations increased in the Eagle Nest Mountain area on the Cascade Ranger District and above Deadwood Reservoir. Newly-infested areas were noted along Clear Creek to East Mountain.

Significant changes in budworm defoliation occurred on the Targhee and Caribou National Forests. Combined, these two Forests have about 90,000 acres of light to heavy defoliation recorded for the first time in recent years. New defoliation on the Targhee is located along the east side of the Big Hole Mountains from Pack Saddle Creek to Teton Pass and between Pine Creek and Big Elk Creek. The Caribou outbreak, except for a small area of defoliation in Smith Canyon, extends from Jacknife Creek north to Garden Creek along the east side of the Caribou Range. A breakdown by defoliation intensity of western spruce budworm infestations in the Intermountain Region during 1978 is shown in Table 1.

The 1978 infestations on the Salmon National Forest occurred in the same general areas as in 1977. An increase in defoliation intensity was noted along Panther Creek and the North Fork of the Salmon River drainage. New areas appeared along the Silver Creek drainage and in

Table 1. Areas of visible defoliation by western spruce budworm in the Intermountain Region during 1978 as determined by aerial surveys.

AREA	DEFOLIATION INTENSITY (ACRES) LIGHT	MODERATE	HEAVY	TOTAL
Boise N.F.	33,500	95,800	98,700	228,000
Bridger-Teton N.F.	42,200	86,600	70,800	199,600
Caribou N.F.	17,000	12,600	8,600	38,200
Challis N.F.	--	--	51,700	51,700
Payette N.F.	21,400	82,000	205,500	308,900
Salmon N.F.	28,500	116,300	38,400	183,200
Targhee N.F.	44,900	51,500	9,400	105,800
Grand Teton N.P.	300	2,100	800	3,200
Idaho Primitive Area				338,400[1]
TOTAL	187,800	446,900	483,900	1,457,000

[1] Defoliation intensities were not recorded in the Idaho Primitive Area.

the Yellowstone Creek-Shovel Creek area on the southern part of the Forest.

In 1977, 500 acres of new defoliation were discovered on Blacktail Butte in Grand Teton National Park, Wyoming, on lands adjacent to the Bridger-Teton National Forest. New defoliation occurred to the north and west of Blacktail Butte in 1978. This defoliation, located between Phelps Lake and Leigh Lake along the base of the Teton Mountains, is visible to Park visitors. The largest area of new defoliation was observed in the lower portion of Pilgrim Creek southeast to Lozier Hill.

Defoliation on the Payette National Forest remained severe, especially between the Weiser River and the South Fork of the Salmon River

(Figure 2). Decreases in defoliation were experienced in areas of older infestations. The most spectacular of these occurred in the Boulder Creek drainage, where virtually no new defoliation was found over the area extensively defoliated in 1977. Decreases were also noted west of the South Fork of the Salmon River above Lick Creek, and west of Goose Lake. Increases in intensity and area appeared in younger areas of defoliation in the Weiser River drainage northward and in the Sloans Point area where the spreading infestation now joins that of the Boise National Forest.

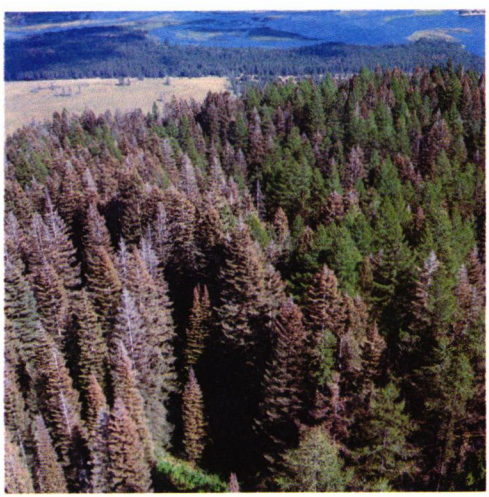

Figure 2. Western spruce budworm defoliation near No Business Mountain, McCall Ranger District, Payette National Forest.

Budworm infestations on the Challis National Forest occurred in the same areas as in 1977. Defoliated stands just outside the Idaho Primitive Area suffered moderate to heavy damage compared to predominantly light defoliation in 1977.

Defoliation in the Idaho Primitive Area increased by 47,400 acres for a total of 338,400 acres. The Primitive Area falls on four National Forests south of the Salmon River; however, it is considered a separate entity for budworm acreage estimates.

A small area of light defoliation was found west of Monticello, Utah, on the Manti-LaSal National Forest. This damage was not visible from the air and its extent is unknown.

A proposal to spray western spruce budworm on the Boise and Payette National Forests in 1978 was evaluated through the NEPA process and an Environmental Impact Statement was written. The operational project was deferred until additional information is obtained.

Table 2 depicts budworm activity for the past 15 years in the Intermountain Region.

Table 2. Areas of visible defoliation by the western spruce budworm in the Intermountain Region during the past 15 years as determined by aerial surveys.

	DEFOLIATION INTENSITY (ACRES)			
YEAR	LIGHT	MODERATE	HEAVY	TOTAL
1964	266,000	658,000	1,352,000	2,276,000
1965	465,600	254,500	795,200	1,515,300
1966	923,900	52,200	16,100	992,200
1967	162,200	54,900	1,600	218,700
1968	333,500	150,200	21,800	505,500
1969	388,800	125,400	30,200	544,400
1970	223,200	79,300	5,200	307,700
1971	229,300	110,300	34,300	373,900
1972	395,300	100,700	9,500	505,500
1973	99,700	76,400	48,000	224,100
1974	234,900	111,300	11,600	357,800
1975	568,800	130,900	33,700	733,400
1976	265,100	213,000	218,300	1,084,000[1]
1977	195,400	213,300	288,600	988,300[2]
1978	187,800	446,900	483,900	1,457,000[3]

[1] Includes an additional 387,600 acres in the Idaho Primitive Area not recorded by defoliation intensity.

[2] Includes an additional 291,000 acres in the Idaho Primitive Area not recorded by defoliation intensity.

[3] Includes an additional 338,400 acres in the Idaho Primitive Area not recorded by defoliation intensity.

Douglas-fir tussock moth, *Orgyia pseudotsugata* **McDunnough**

No defoliation was reported in forested areas; however, larvae were collected from a blue spruce in Boise, Idaho. The 35-foot tall tree had five feet of its crown defoliated.

Western tussock moth, *Orgyia cana* **(Edwards)**

Ceanothus and other shrub species were defoliated by the western tussock moth over 3,200 acres in scattered locations north, east, and west of Idaho City and north of Centerville on the Boise National Forest.

White fir needle miner, *Epinotia meritana* **Heinrich**

Light to heavy defoliation of white fir occurred on approximately 3,000 acres along the East Fork of the Sevier River, Dixie National Forest. This infestation has persisted for several years, resulting in growth loss and localized tree mortality. In the past, defoliation has been confined to areas in and near Cougar Hollow and Blue Fly Creek. During 1978, defoliation was recorded in Upper Kanab, Skunk, and Badger Creeks.

Ponderosa pine needle miner, *Coleotechnites* **sp.**

Needle miner populations reported on the North Fork Ranger District, Salmon National Forest, in 1977 were observed there again in 1978 as well as in the Carmen Creek drainage on private land. A second infestation was found on the Boise National Forest, southeast of Sagehen Reservoir, Emmett Ranger District. Needle mining in ponderosa pine on the Council Ranger District, Payette National Forest, was also reported.

Fall cankerworm, *Alsophila pometaria* **(Harris)**

Following a year of reduced defoliation, the fall cankerworm caused moderate to heavy defoliation around lower Corn Creek on the Fishlake National Forest during 1978. Heaviest defoliation occurred on boxelder in Adelaide Campground, while cottonwood received only incidental defoliation.

Gypsy moth, *Lymantria dispar* **(L.)**

In cooperation with APHIS, the Forest Service has conducted a detec-

tion survey for the gypsy moth in parts of southern Utah for several years. Pheromone-baited traps were placed in major tourist areas where suitable host trees were abundant. Such areas were selected due to their proximity to major east-west tourist routes. A male gypsy moth was trapped in Zion National Park, making this the first collection of this insect in the Intermountain West. Efforts are underway to expand the detection survey to determine if gypsy moth has become established in Zion National Park and to be prepared for population increases. Occasional detections, however, do not necessarily indicate a developing infestation.

Leafroller, *Archips negundanus* (Dyar)

A long-standing infestation of this leafroller continued along the Wasatch Front and other canyon locations to the east. Boxelder in the Ogden area showed a decrease in defoliation while Daniels Canyon and lower Spanish Fork Canyon on the Uinta National Forest, Utah, had extreme defoliation (Figure 3). No tree mortality has been reported.

Figure 3. **Boxelder defoliated by *Archips negundanus* (Dyar) in Daniels Canyon, Heber Ranger District, Uinta National Forest.**

Pine sawfly, *Neodiprion fulviceps* **Cresson**

Heavy defoliation of ponderosa pine in Clear Creek on the Fishlake National Forest continued during 1978. Branch mortality is common in this isolated stand of ponderosa pine, but tree mortality is light, despite many years of repeated defoliation.

Pine sawfly, *Neodiprion* **sp.**

Sawfly larvae feeding on ponderosa pine buds and needles were noted in a 13-acre Lucky Peak Nursery outplanting on the Emmett Ranger District, Boise National Forest.

A tiger moth, *Halisidota ingens* **Hy. Edw.**

A new infestation of this defoliator was reported on ponderosa pine along Carpenter Ridge, Manti-LaSal National Forest in Colorado. Some top killing has occurred, but the long-range impact is unknown.

Larch casebearer, *Coleophora laricella* **(Hübner)**

Approximately 500 acres of defoliation by larch casebearer were detected during an early June aerial survey in the Elkhorn Creek drainage on the Payette National Forest. The Braconid, *Agathis pumila* (Ratz.), an imported wasp parasite of larch casebearer, was collected in northern Idaho in cooperation with the Idaho Department of Lands and released in casebearer-infested larch stands on the Payette and Boise National Forests, State and private lands. Previously, the wasp was not known to occur south of the Salmon River.

OTHER INSECTS

Black pine-leaf scale, *Nuculaspis californicus* **Coleman**

Populations of this insect started to decline after five years of activity on a 400-acre ponderosa and Jeffrey pine site near Genoa, Nevada. Examination of five study plots established within the infestation in 1976 indicates that the majority of the defoliated trees are recovering.

Repeated defoliation has resulted in some scattered tree mortality which has occurred primarily as a result of increased populations of secondary insects such as the red turpentine beetle and one or more species of flatheaded borers. These insects have successfully attacked and killed the severely defoliated and drought-weakened trees.

This activity can be expected to continue for the next two to three years. In order to reduce this mortality, it has been recommended that concerned private landowners provide supplemental watering for trees favored as ornamentals and remove all severely distressed trees larger than 8" dbh.

PATHOLOGY

Dwarf mistletoe, *Arceuthobium* spp.

A Regionwide survey was conducted to assess the incidence of and cubic-foot volume loss due to lodgepole pine dwarf mistletoe, *Arceuthobium americanum* Nutt. ex Engelm.; ponderosa pine dwarf mistletoe, *A. campylopodum* Engelm.; and *A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. and Wiens. Douglas-fir stands were also surveyed for dwarf mistletoe, *A. douglasii* (Engelm.), for future analysis with proposed Douglas-fir yield simulation models. The survey consisted of two parts — a roadside rating and plot inspections. About 3,300 miles of roads within 13 Forests were surveyed, with temporary plots established every 3 miles. The survey information is currently being processed. An additional survey on the Dixie National Forest will also add to the Regional dwarf mistletoe loss assessment information.

A presuppression survey on the Payette National Forest was conducted to evaluate proper dwarf mistletoe control on 150 new and old clearcut areas. The initial results indicate that dwarf mistletoe control is being satisfactorily effected through normal silvicultural procedures.

Forest Insect and Disease Management surveys and funding were also provided to support dwarf mistletoe control projects. The following figures indicate the number of acres of forested land that were protected from future dwarf mistletoe infection through sanitation and overstory removal.

These include:
- 141 acres on the Ashley National Forest
- 500 acres on the Dixie National Forest
- 79 acres on the Salmon National Forest
- 3,710 acres on the Targhee National Forest
- 100 acres on the Wasatch National Forest

Lodgepole pine needle cast, *Lophodermella concolor* (Dearn.) Dark

Many areas of lodgepole pine on the Payette, Boise, Challis, and Salmon National Forests experienced a widespread needle cast epiphytotic (Figure 4). Trees on affected sites in some areas showed needle loss back to 1974. Light mortality of seedlings and saplings was observed in some of the more heavily infected stands. Repeated heavy infections can reduce all but the current year's growth.

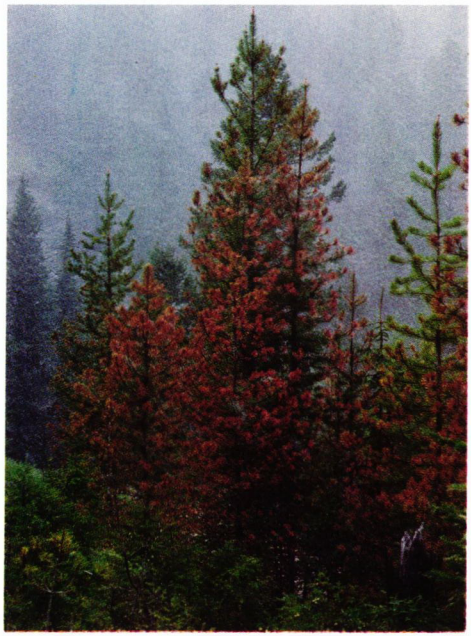

Figure 4.
Lodgepole pine needle cast in the Carmen Creek drainage, Salmon Ranger District, Salmon National Forest.

Elytroderma needle cast, Elytroderma deformans **(Weir) Dark**

This disease was scattered in ponderosa pine stands throughout the Boise and Payette National Forests, as well as on other ownerships. Heavy occurrence of witches' brooms and single red-brown flags were observed in Long Valley, around Warm Lake, in Mores, Grimes, and Squaw Creeks, and in the Boise River drainages.

Greybeard, *Lophodermium* **sp.**

This needle disease was observed on the Idaho City and Boise Ranger Districts, Boise National Forest, but is believed to be widespread throughout the ponderosa pine type on this Forest. Signs of the disease in the areas of Grimes Creek, Mores Creek, and the North Fork of the Boise River included gray, dead interior needles and incidental mortality of sapling and pole-sized ponderosa.

Dutch elm disease, *Ceratocystis ulmi* (Buisman) C. Moreau

Contingency plans were drafted and submitted to the States of Utah and Nevada. Several assistance calls were made during the field season to examine trees thought to have the disease, but laboratory and field studies did not corroborate any areas of infection. Therefore, it is assumed that these two States are still free of the elm wilting disease. The State of Utah is completing an inventory of street-tree species.

Drought damage

The drought of 1974-1977 caused direct mortality to some trees on poorer sites. In the spring of 1978, an evaluation was made on about 500 acres of Jeffrey-ponderosa pine west of Washoe Valley, Nevada. Dead and dying trees were located along an environmental ecotone that represented the interface of a sagebrush/mountain mahogany-dominated grassland with a Jeffrey/ponderosa pine forest. Along the interface the pine was not in a self-reproducing capacity.

Both dead and dying trees were evaluated in the field and samples were examined in the lab. Dying trees were noticeably wilted in appearance. The older needles abcissed prematurely and fading was more pronounced on the side of the tree that received direct sunlight.

No primary pathogens or insects were found. Therefore, it is believed that the observed mortality is a result of extreme water stress resulting from a depletion of ground water occurring during the period of subnormal precipitation. An examination of weather data, specifically precipitation, at Reno and Carson City, Nevada, provided support for this conclusion, which was based on both field and office investigations. It is also speculated that the affected ponderosa and Jeffrey pine, as well as their associated crosses, may be local strains of genetically inferior trees in terms of drought resistance. This may account for the lack of tree decline and mortality throughout the Nevada Sierra Front.

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DISTRIBUTION OF MAJOR FOREST INSECT INFESTATIONS IN REGION 4*

1978

LEGEND

- *Mountain Pine Beetle*
- *Douglas-fir Beetle*
- *Western Spruce Budworm*
- *Ips Engraver Beetle*

Based on aerial and ground surveys

STATE AND PRIVATE FORESTRY

FOREST SERVICE

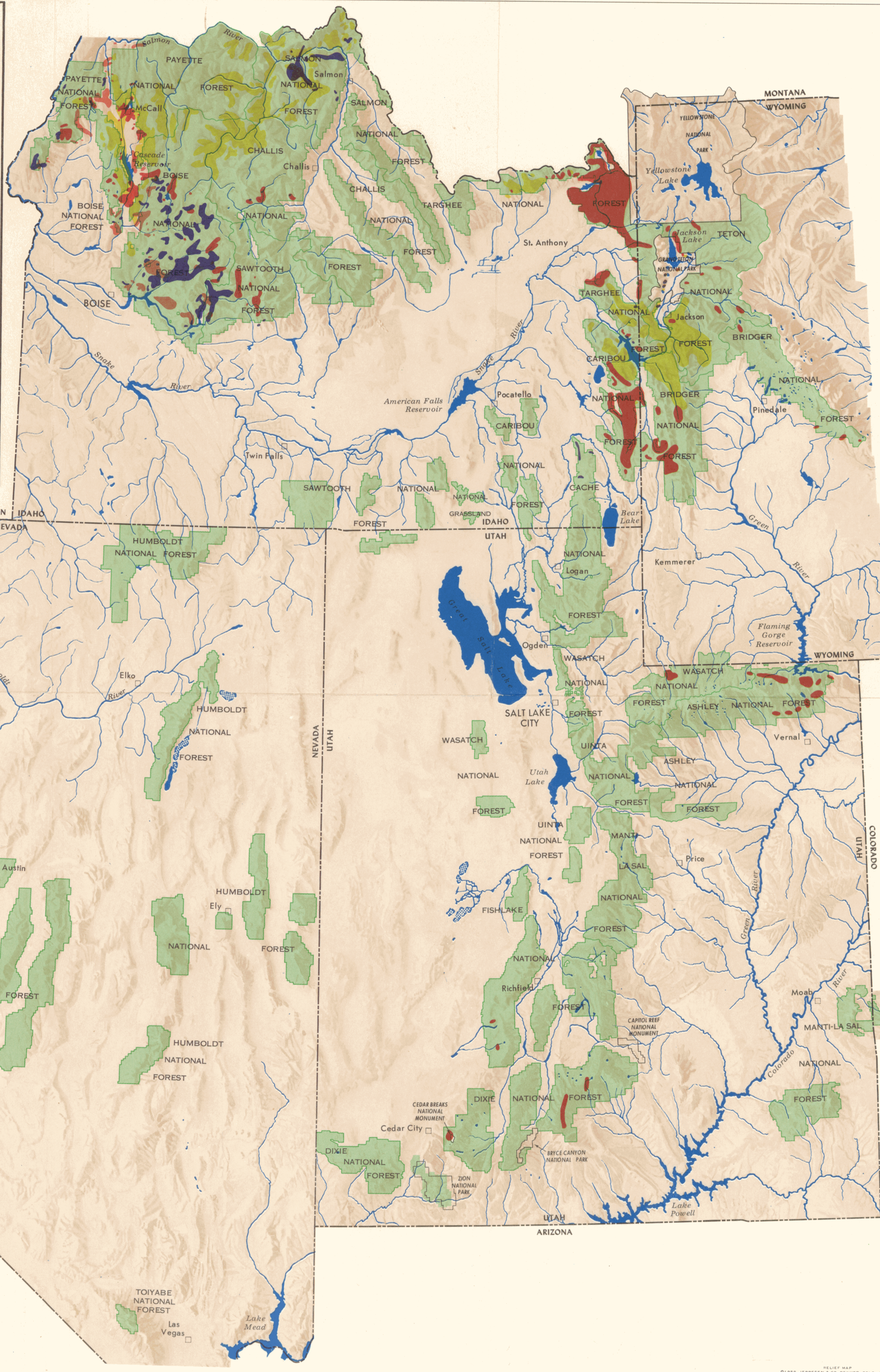
U. S. DEPARTMENT OF AGRICULTURE

SCALE

miles

0 40

*Recent reorganization has resulted in numerous boundary changes which are not shown on this map. In addition portions or several National Forests were not shown.



RELIEF MAP
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